

CHAPTER 11

OXYGEN COMPONENTS TEST STANDS

Learning Objective: Upon completion of this chapter, you will be able to identify, maintain, and perform periodic inspections on oxygen components test stands.

Aircrew Survival Equipmentmen are responsible for shop testing aircraft oxygen system components, including regulators, emergency oxygen systems, and other items. The AME is responsible for checking system components in the aircraft; however, in case of a suspected malfunction and for periodic maintenance testing, the component is removed from the aircraft and brought to the oxygen shop where it is tested by the PR. This testing is accomplished with the use of various types of test equipment, some of which are discussed in this chapter.

OXYGEN

No one can live without sufficient quantities of food, water, and oxygen. Of the three, oxygen is by far the most urgently needed. If necessary, a well-nourished individual can go without food for many days or weeks, living on what is stored in the body. The need for water is more immediate, but still the need does not become critical for several days. The amount of oxygen in the body is limited at best to a few minutes supply. When that supply is exhausted, death is prompt and inevitable.

Oxygen starvation affects a pilot or aircrewman in much the same way that it affects an aircraft engine—neither can function without it. The engine requires oxygen for burning the fuel that keeps it going. An engine designed for low-altitude operation loses power and performs poorly at high altitudes. High-altitude operation demands a means of supplying air at higher pressure to give the engine enough oxygen for the combustion of its fuel. The supercharger or compressor performs this function.

The combustion of fuel in the human body is the source of energy for everything the aviator

is required to do with his muscles, with his eyes, and with his brain. As the aircraft climbs, the amount of oxygen per unit of volume of air decreases; therefore, the aviator's oxygen intake is reduced. Unless he/she breathes additional oxygen, the eyes, the brain, and the muscles begin to fail. The body is designed for low-altitude operation and will not give satisfactory performance unless it is supplied the full amount of oxygen that it requires. Like the engine, the body requires a means of having this oxygen supplied to it in greater amounts or under greater pressure. This need is satisfied by the use of supplemental oxygen supplied directly to the respiratory system through an oxygen mask, by pressurizing the aircraft to an atmospheric pressure equivalent to that of safebreathing altitudes, or both.

For purposes of illustration, an aviator's lungs may be compared to a bottle of air. If an open bottle is placed in an aircraft at sea level, air escapes from it continuously as the aircraft ascends. The air pressure at 18,000 feet is only half the amount as that at sea level; therefore, at 18,000 feet the bottle is subjected to only half the atmospheric pressure it was subjected to at sea level. For this reason, it will contain only half the oxygen molecules it had when on the ground.

In like fashion, an aviator's lungs contain less and less air as he/she ascends, and correspondingly less oxygen. Thus, the use of supplemental oxygen is an absolute necessity on high-altitude flights. Above 35,000 feet, normal activity is possible up to about 43,000 feet by use of positive pressure equipment. This equipment consists of a "supercharger" arrangement by which the oxygen is supplied to the mask under a pressure slightly higher than that of the surrounding atmosphere. Upon inhalation, the

oxygen is forced into the lungs by the system pressure. Upon exhalation, the oxygen flow is shut off automatically so that carbon dioxide can be expelled from the mask. Normal activity is possible to 50,000 feet with the use of a pressure breathing oxygen regulator. Above 50,000 feet, the only adequate provision for the safety of the aviator is pressurization of the entire body.

Up to about 35,000 feet, an aviator can keep a sufficient concentration of oxygen in his/her lungs to permit normal activity by use of demand oxygen equipment, which supplies oxygen upon demand (inhalation). The oxygen received by the body on each inhalation is diluted with decreasing amounts of air up to about 30,000 feet. Above this altitude up to about 35,000 feet, this equipment provides 100-percent oxygen. At about 35,000 feet, inhalation alone will not provide enough oxygen with this equipment.

EFFECTS OF HYPOXIA

A decrease in the amount of oxygen per unit volume of air results in an insufficient amount of oxygen entering the bloodstream. The body reacts to this condition rapidly. This deficit in oxygen is called HYPOXIA. A complete lack of oxygen, which causes death, is called ANOXIA. If the body is returned to its normal oxygen supply, one may recover from hypoxia, but cannot recover from anoxia.

Many persons are not aware of the enormous increase in the need for oxygen caused by an increase in physical activity. Strenuous calisthenics or a cross-country run results in deep and rapid breathing. Even so mild an exercise as getting up and walking around a room may double the air intake. In the case of the aviator, a leaking oxygen mask that may go completely unnoticed while the wearer is at rest may lead to collapse and unconsciousness when he/she attempts to move about from one station to another in the aircraft. A walkaround (portable) oxygen bottle sufficient for 24 minutes of quiet breathing may be emptied by 17 minutes of use when the user is moving about the aircraft.

People differ in their reactions to hunger, thirst, and other sensations. Even an individual's reactions vary from time to time under different circumstances. Illness, pain, fear, excessive heat or cold, and many other factors govern what the

response will be in each particular case. The same thing is true of individual reactions to oxygen starvation. The effects of a certain degree of hypoxia on a given person cannot be accurately predicted. For instance, a person may be relatively resistant on one day, but highly susceptible the next.

It is difficult to detect hypoxia, because its victim is seldom able to judge how seriously he/she is affected, or often that he/she is affected at all. The unpleasant sensations experienced in suffocation are absent in the case of hypoxia. Blurring of vision, slight shortness of breath, a vague weak feeling, and a little dizziness are the only warnings. Even these may be absent or so slight as to be unnoticeable.

While still conscious, the aviator may lose all sense of time and spend his last moments of consciousness in some apparently meaningless activity. In such a condition, the aviator is a menace to the crew as well as to himself. Since the aviator understands that it is the reduced air pressure at higher altitudes that determines the effect upon the body, he/she depends upon the altimeter rather than sensations or judgment to tell when oxygen is needed.

CHARACTERISTICS OF OXYGEN

Oxygen, in its natural state, is a colorless, odorless, and tasteless gas. Oxygen is considered to be the most important to life of all the elements. It forms about 21 percent of the atmosphere by volume and 23 percent by weight.

Of all the elements in the universe, oxygen is the most plentiful. It makes up nearly one-half of the earth's crust and approximately one-fifth of the air we breathe.

Oxygen combines with most of the other elements. The combining of an element with oxygen is called oxidation. Combustion is simply rapid oxidation. In almost all oxidations, heat is given off. In combustion, the heat is given off so rapidly it does not have time to be carried away; the temperature rises extremely high, and a flame appears.

Some examples of slow oxidation are the rusting of iron, drying of paints, and the changing of alcohol into vinegar. Even fuels in storage are

slowly oxidized, the heat usually being carried away fast enough; however, when the heat cannot easily escape, the temperature may rise dangerously and a fire will break out. This is called spontaneous combustion.

Oxygen does not burn, but does support combustion. Nitrogen neither burns nor supports combustion. Therefore, combustible materials burn more readily and more vigorously in oxygen than in air, since air is composed of about 78 percent nitrogen by volume and only about 21 percent oxygen.

In addition to existing as a gas, oxygen can exist as a liquid and as a solid. Liquid oxygen is pale blue in color. It flows like water, and weighs 9.54 pounds per gallon.

Liquid oxygen, commonly referred to as LOX, is normally obtained by a combined cooling and pressurization process. When the temperature of gaseous oxygen is lowered to -182°F under about 750 psi pressure, it will begin to form into a liquid. When the temperature is lowered to -297°F , it will remain a liquid under normal atmospheric pressure.

Once converted into a liquid, oxygen will remain in its liquid state as long as the temperature is maintained below -297°F . The liquid has an expansion ratio of 862 to 1, which means that one volume of liquid oxygen will expand 862 times when converted to a gas at atmospheric pressure. Thus, 1 liter of liquid oxygen produces 862 liters of gaseous oxygen.

Until a few years ago, all oxygen carried in naval aircraft was in the gaseous state. As flight durations increased, however, it was found that the weight and space problems involved with carrying increasing amounts of gaseous oxygen were becoming intolerable. LOX has proven the answer to these problems. In its liquid state, oxygen can be "packed" into containers small and light enough to be carried even in fighter-type aircraft without weight and space penalty.

In the aircraft, oxygen in the liquid state is carried in a container called a converter. This is a double-walled, vacuum-insulated container similar to the common Thermos bottle. The converter is equipped with the necessary valves and tubing for vaporizing the liquid and warming the gas to cockpit temperatures.

TYPES OF OXYGEN

Aviator's breathing oxygen (MIL-O-27210C) is supplied in two types (I and II). Type I is gaseous oxygen, and type II is LOX. Oxygen procured under the above specification is required to be 99.5 percent pure. The water vapor content must not be more than 0.02 milligram per liter when tested at 70°F and at sea level pressure. This is practically bone dry.

Technical oxygen, both gaseous and liquid, is procured under specification BB-0-925. The moisture content of technical oxygen is not as rigidly controlled as that of breathing oxygen; therefore, the technical grade should never be used in aircraft oxygen systems.

The extremely low moisture content required of breathing oxygen is not to avoid physical injury to the body, but to ensure proper operation of the oxygen system. Air containing a high percentage of moisture can be breathed indefinitely without any serious ill effects. However, the moisture affects the aircraft oxygen system in the small orifices and passages in the regulator. Freezing temperatures can clog the system with ice and prevent oxygen from reaching the user. Therefore, extreme precautions must be taken to safeguard against the hazards of water vapor in oxygen systems.

OXYGEN COMPONENT TEST STAND 1172AS100

Regulator test stands are designed for testing oxygen regulators for flow capacities, oxygen concentrations, pressure characteristics, and various leakage tests at different simulated altitudes. There are several models of test stands capable of testing the oxygen regulators, converters, etc. We will cover only the ones that most oxygen shops throughout the Navy use. If you happen to work in an oxygen shop that is using outdated equipment, ask the petty officer in charge of the work center to show you the literature that covers that equipment. In this rate training manual, we will discuss only the 1172AS100 test stand used for testing oxygen regulators.

The Oxygen System Components Test Stand, Model 1172AS100, tests and evaluates miniature oxygen breathing regulators as well as panel and

console mounted oxygen breathing regulators. (See figure 11-1.)

Oxygen system components test stands are supplied by more than one manufacturer. The operation, maintenance, and parts are, with a few minor exceptions, identical. Where there are differences in applications, or where operational procedures differ, they will be redescribed in the individual regulator chapters of NAVAIR Publication 13-1-6.4. Therefore, before you attempt to test any oxygen component, you should refer to that manual.

The oxygen system components test stand consists of a nitrogen pressure source and a vacuum system. It includes the valving and instrumentation necessary to measure, test, and evaluate the performance and operating characteristics of oxygen system components at altitudes up to 150,000 feet.

Performance of the test stand is dependent upon the skill of the operator. You must be thoroughly familiar with the instruments, controls, and connections that comprise the systems that are incorporated within the test stand (fig. 11-1).

ON/OFF VALVES

There are two ON/OFF valves on the test stand. These valves are colored red and have two positions—ON and OFF. The first valve is called the inlet pressure ON/OFF valve (L). This valve permits a flow of regulated high-or low-pressure nitrogen to the input connection (18) located inside the altitude chamber. The second ON/OFF valve is called the Leakage ON/OFF valve (G). This valve permits a flow of regulated low-pressure nitrogen gas (N_2) through the selected in-system rotameter (7) or (8). You select either the low-range or the high-range rotameter by using the leakage selector valve (F). Valve (G), the leakage ON/OFF valve, also permits a supply of N_2 to go to the input connection (18) inside the chamber. The only time you will be using ON/OFF valve (G) is when you are adjusting the bleed on a miniature oxygen regulator (this is covered in the NAVAIR 13-1-6.4) and when you are measuring leakage on oxygen components.

SELECTOR VALVES

As you look at the Model 1172AS100 test stand, you may think that with all those different valves, gauges, rotameters, and connections that you could never operate it. However, by operating

only four selector valves, you can direct the flow of N_2 to perform the basic functions of the stand. These valves are M, O, D, and F, shown in figure 11-1.

The FLOW SELECTOR valve (M) has two positions—CONTROLLER and REGULATOR. When this valve is placed in the REGULATOR position, and you open the OUTPUT valve (C), the flow is routed directly from the item under test through the piezometer (26) and OUTPUT port (23) to the vacuum pump. When the selector valve is placed in the CONTROLLER position, the flow is routed through the suit simulator tank.

The REFERENCE PRESSURE SELECTOR valve (O) is a two-position valve. It references pressure to either the altitude chamber or the suit simulator tank from LOW RANGE ALTIMETER (13).

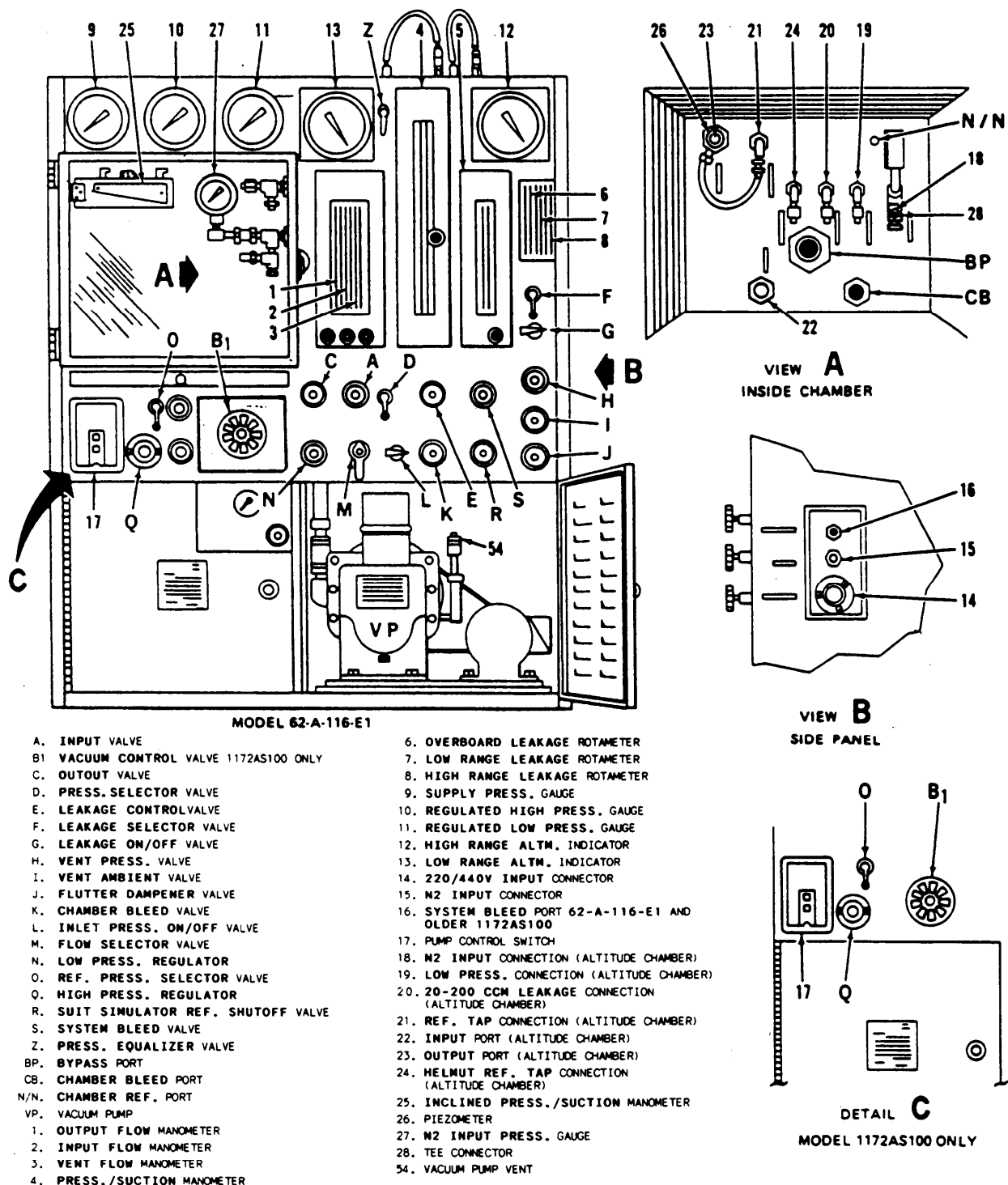
The PRESSURE SELECTOR valve (D) has two positions— H_2O (water) and Hg (mercury). In the Hg position, only mercury pressure can be read. In the H_2O position, either inches of water pressure (positive pressure) or inches of water suction (negative pressure) can be read.

The LEAKAGE SELECTOR valve (F) has two positions—HIGH and LOW. It routes regulated low pressure through the in-system rotameters. When the valve is placed in the LOW position, leakage is indicated on rotameter (7). The LEAKAGE SELECTOR valve (F) is always left in the HIGH position unless you are reading a leak or bleed below 200 cubic centimeters (CCM). This is done to prevent damage to the low-range rotameter in the event you develop a severe leak.

VOL-O-FLO ELEMENTS

To understand the function of some of the valves discussed in the following paragraphs, it is necessary to first understand the function of the Vol-O-Flo elements installed between certain control valves and their indicating manometers. There are three Vol-O-Flo elements installed on the test stand. The input Vol-O-Flo works in conjunction with INPUT valve (A) and INPUT FLOW manometer (2). The output Vol-O-Flo is used with OUTPUT valve (C) and OUTPUT FLOW manometer (1). The vent flow Vol-O-Flo is used with either the VENT PRESSURE valve (H) or the VENT AMBIENT valve (1) and the VENT FLOW manometer (3).

The Vol-O-Flo elements have two taps—one near the inlet end and one near the outlet end.



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Figure 11-1.-Controls and indicators for Oxygen System Components Test Stand Model 117AS100.

(See figure 11-2.) Baffles inside the element create a flow restriction. As air or nitrogen enters the element, a pressure buildup is created at the inlet end; as it flows past the baffles, a pressure drop occurs at the outlet end. The inlet (pressure buildup) tap is connected to the bottom of the indicating manometer, and the outlet (pressure drop) tap is connected to the top of the manometer. As the control valve is opened, gas flows from the valve through the Vol-O-Flo, and the pressure drop thus created allows the fluid in the manometer to rise. The operator reads the amount of flow passing through the Vol-O-Flo on the indicating manometer.

CONTROL VALVES

A control valve regulates, or restricts, a specified flow. Two types of control valves, measuring and nonmeasuring, are used on the test stand. Measuring control valves have measuring devices (gauges or manometers) to visually measure the flow through the valve as it is opened. Nonmeasuring control valves have no indicating devices. There are six measuring and three nonmeasuring control valves on the test stand.

Measuring Control Valves

The measuring control valves (fig. 1 1-l) are as follows:

1. The INPUT valve (A) allows a measurable flow of air into the altitude chamber. It can only

be used during simulated altitude conditions. As the chamber altitude increases, pressure inside the chamber decreases, and the ambient air pressure outside the chamber is greater. When valve (A) is opened, air from outside the chamber flows through valve (A); through the input Vol-O-Flo element, indicating the amount of air flow on the INPUT FLOW manometer (2); and through the INPUT port (22) into the chamber.

2. The VACUUM CONTROL valve (B1) on Model 1172AS100 allows direct evacuation of the altitude chamber to the desired simulated altitude by decreasing pressure in this chamber.

3. The OUTPUT valve (C), when opened, draws a direct flow from the item under test through the piezometer (26), OUTPUT port (23), FLOW SELECTOR valve (M) and the output Vol-O-Flo element to the vacuum pump. As the flow passes through the output Vol-O-Flo, the pressure is displayed on the OUTPUT FLOW manometer (1).

4. The LEAKAGE CONTROL valve (E) controls the flow to the LOW-PRESSURE connection (19), which is located inside the chamber. As the name of the valve implies, it is used to perform various leak tests on oxygen components. When you use the LEAKAGE CONTROL valve (E) to perform leakage tests on components, a line with bayonet fittings must be installed between the LOW-PRESSURE connection (19) and the REFERENCE-TAP connection (21). This allows the flow passing

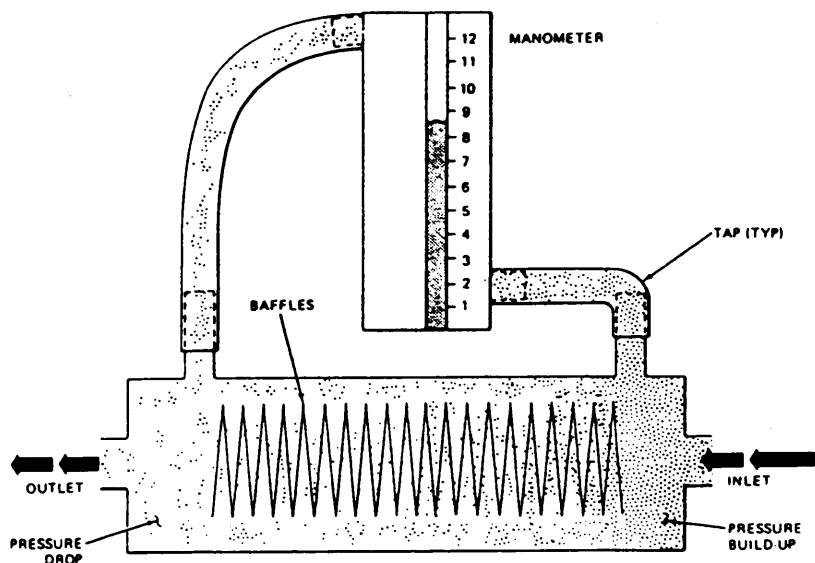


Figure 11-2.—VOL-O-FLO element.

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through valve (E) to be indicated on PRESSURE/SUCTION manometer (4) or Hg manometer (5), whichever you have selected. Any leakage would be registered on rotameters (7) or (8).

5. The VENT PRESSURE valve (H) controls a vent flow of low pressure through the suit simulator tank to the item under test at sea level. When valve (H) is opened, nitrogen (N_2) flows through the vent flow Vol-O-Flo element, and is indicated on VENT FLOW manometer (3). The flow then passes to the suit simulator tank, through FLOW SELECTOR valve (M), OUTPUT connection (23) and piezometer (26) to the item under test. Valve (H) is primarily used for testing relief valves.

6. The VENT AMBIENT valve (I) serves the same purpose as VENT PRESSURE valve (H), except that valve (H) is used at sea level with supply pressure, while valve (I) is used at altitude and uses ambient air as the pressure source to conserve N_2 . Therefore, valve (I) can be considered an economizer valve, used only "at altitude."

Nonmeasuring Control Valves

The nonmeasuring valves (fig. 11-1) are opened only as much as necessary. Flow through these valves cannot be measured or gauged. The nonmeasuring valves are as follows:

1. The FLUTTER DAMPENER valve (J) allows an opening from the suit simulator tank to the line connecting FLOW SELECTOR valve (M) and OUTPUT valve (C). It acts as a dampener to prevent fluttering of specific regulator diaphragms during testing, and allows a flow to be drawn from a test item through the suit simulator tank when FLOW SELECTOR valve (M) is in the CONTROLLER position.

2. The CHAMBER BLEED valve (K) is used to bring the chamber to sea level from a simulated altitude.

3. The SYSTEM BLEED valve (S) is used to bleed N_2 pressure from systems of the test stand through SYSTEM BLEED port (16). On later configurations of Model 1172AS100, SYSTEM BLEED port (16) has been deleted. N_2 pressure is bled directly from a port incorporated in the SYSTEM BLEED valve (S).

SHUTOFF VALVES

There is only one shutoff valve on the 1172AS100 test stand (fig. 11-1). It is the SUIT

SIMULATOR REFERENCE SHUTOFF valve (R). It is used to prevent damage to other components. The SUIT SIMULATOR REFERENCE SHUTOFF valve shuts off the suit simulator tank from REFERENCE PRESSURE SELECTOR valve (O) and HELMET REFERENCE TAP (24). When you use a shutoff valve, you should fully open the valve, and then turn it back one-fourth turn.

CAUTION

IF SUIT SIMULATOR VALVE (R) IS LEFT OPEN WITH REFERENCE PRESSURE SELECTOR VALVE (O) IN THE SUIT SIMULATOR TANK POSITION, DAMAGE COULD OCCUR TO LOW RANGE ALTM (13) IF EXCESSIVE PRESSURE IS APPLIED TO IT WITH VENT PRESSURE VALVE (H).

REGULATORS

There are two regulators on the 1172AS100 test stand (fig. 11-1). They control the supply pressure to the specific system being used. The regulators are as follows:

1. The HIGH PRESSURE REGULATOR (Q), which is pneumatically operated. It supplies regulated high pressures from 250 pounds per square inch, gauge (psig) to the maximum capacity of the supply cylinder being used. Regulator (Q) has three positions—LOAD, NEUTRAL, and VENT. It is spring loaded in the NEUTRAL position. Pressure being loaded is indicated on REGULATED HIGH PRESSURE gauge (10).

2. The LOW PRESSURE REGULATOR (N), which is mechanically operated, supplies regulated low pressure to the item under test, the in-system rotameters, and the suit simulator tank. Regulator (N) has a range of 0 to 180 psig. The pressure being loaded is displayed on REGULATED LOW PRESSURE gauge (11), and is also displayed on N_2 INPUT gauge (27) when the INLET PRESSURE ON/OFF valve (L) is in the ON position.

GAUGES AND INDICATORS

Gauges and indicators incorporated in the test stand (fig. 11-1) indicate pressures or flows. Some indicate in pounds per square inch, gauge (psig), some in feet, inches of mercury (inches Hg),

millimeters of mercury (mm Hg), inches of water (inches H₂O), or cubic centimeters per minute (CCM). Their functions are self-explanatory.

1. The SUPPLY PRESSURE gauge (9) is a 0 to 3,000 psig gauge and indicates supply cylinder pressure.

2. The REGULATED HIGH PRESSURE gauge (10) is a 0 to 3,000 psig gauge and indicates regulated high pressure.

3. The REGULATED LOW PRESSURE gauge (11) is a 0 to 200 psig gauge and indicates regulated low pressure.

4. The INPUT PRESSURE gauge (27) is a 0 to 160 psig gauge and indicates regulated low pressure.

5. The LOW RANGE ALTM (13) measures chamber altitude pressure and, under some circumstances, suit simulator tank pressure. It measures pressures equivalent to altitudes between 10,000 and 40,000 feet.

6. The HIGH RANGE ALTM (12) measures chamber altitude pressure to indicate the altitude range equivalent to between 30,000 and 150,000 feet.

NOTE: Each altimeter incorporates an inner scale, which indicates altitude in mm Hg instead of in feet.

7. The PRESSURE/SUCTION manometer (4) has a range of -12.0 to +26.0 inches H₂O, and measures the amount of differential pressure between piezometer (26) and the altitude chamber, or between the piezometer and the suit simulator tank. It is used during component testing to measure safety pressure and pressure breathing pressures being delivered by the component and to measure suction flows being drawn through the component.

8. The Hg manometer (5) has a range of 0 to 12.0 inches Hg and measures, in inches Hg, the amount of differential pressure between piezometer (26) and the altitude chamber, or between the piezometer and the suit simulator tank. It is used to measure resistance in an item under test.

NOTE: The rotameters used on the test stand are of the variable area type, which means they get progressively larger toward the top, allowing more nitrogen to pass around the ball. The point at which the ball stabilizes is known as the point of dynamic balance. Readings are made across the center of the ball.

9. The OVERBOARD LEAKAGE rotameter (6) has a range of 20 to 200 CCM (1,000 CCM = 1 lpm) and is vented to ambient. It measures leakage, or bleed, from an item under test. This rotameter is calibrated at 14.7 psig at 70°F (ambient air).

10. The LOW RANGE LEAKAGE rotameter (7) has a range of 20 to 200 CCM, and is enclosed in the low-pressure system. It measures leakage, or bleed, from a component under test through LEAKAGE CONTROL valve (E), or LEAKAGE ON/OFF valve (G). This rotameter is calibrated with nitrogen at 70 psig at 70°F.

11. The HIGH RANGE LEAKAGE rotameter (8) has a range of 200 to 2000 CCM. Its function is the same as LOW RANGE LEAKAGE rotameter (7). This rotameter is calibrated at 70 psig at 70°F.

12. The OUTPUT FLOW manometer (1) has a range of 0 to 12.0 inches H₂O. It indicates the amount of output flow from the item under test.

13. The INPUT FLOW manometer (2) has a range of 0 to 12.0 inches H₂O. It indicates the amount of ambient air flowing into the altitude chamber.

14. The VENT FLOW manometer (L3) has a range of 0 to 12.0 inches H₂O. It indicates the amount of supply pressure or ambient air to the suit simulator tank.

TEST STAND CONNECTIONS

Several connections are incorporated in the test stand (fig. 11- 1) for supplying and bleeding pressure to and from the system. These connections are:

1. The N₂INPUT connector (15) is the N₂ supply cylinder connection.

NOTE: The SYSTEM BLEED port (16) has been deleted on later configurations of Model 1172AS100 test stands.

2. The SYSTEM BLEED port (16) bleeds pressure from the various systems.

3. The N₂INPUT connection (18) is provided for components that require inlet pressures. Either regulated high or regulated low pressures can be provided to the connection. The N₂INPUT tee connection (28), N₂INPUT PRESSURE gauge (27) and the gauge guard that protects the input pressure gauge are connected to N₂INPUT connection (18).

CHECK VALVE CONNECTIONS

There are four connections located within the altitude chamber that have check valves incorporated, and require insertion of a bayonet-type fitting to open the connection and route the flow (fig. 11-1). These connections are as follows:

1. The LOW PRESSURE connection (19) provides for a controlled flow of low-pressure nitrogen through LEAKAGE CONTROL valve (E) to the item under test.

2. The 20 to 200 CCM LEAKAGE connection (20) connects the test item to OVERBOARD LEAKAGE rotameter (6), and is used when testing components for leakage or bleed.

3. The REFERENCE TAP connection (21) is a reference tap to differential pressure indicating manometers (PRESSURE/SUCTION manometer (4) and Hg manometer (5)). It also has a reference line that connects piezometer (26) into REFERENCE TAP connection (21) downstream from the check valve.

4. The HELMET REFERENCE TAP connection (24) is a reference tap connected to both suit simulator tank through SUIT SIMULATOR REFERENCE SHUTOFF valve (R) or LOW RANGE ALTM (13) through REFERENCE PRESSURE SELECTOR valve (O).

NOTE: The CHAMBER REFERENCE port (N/N), also located within the chamber, references chamber pressure to ALT CONTROLLER (B), PRESSURE/SUCTION manometer (4), Hg manometer (5), LOW RANGE ALTM (13), and HIGH RANGE ALTM (12).

Line traps, float check valves, and relief valves are not shown in figure 11-1.

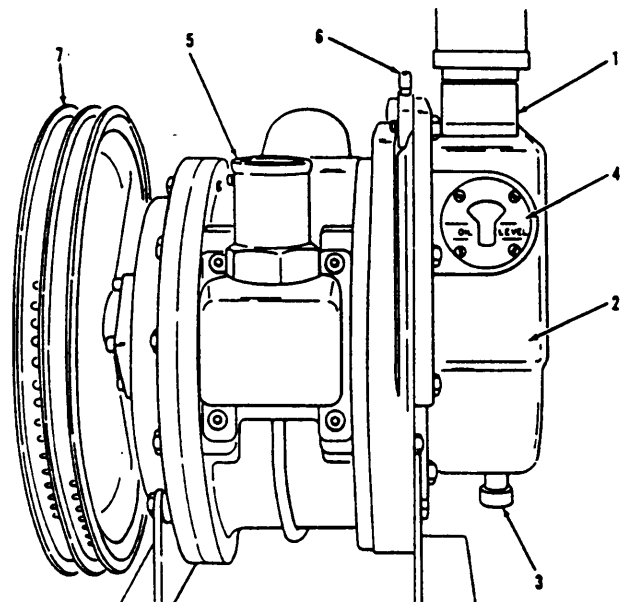
Line traps are incorporated in PRESSURE/SUCTION manometer (4) and Hg manometer (5) to trap liquids in case manometers are overloaded.

The float check valves incorporated in the OUTPUT FLOW manometer (1), the INPUT FLOW manometer (2), the VENT FLOW manometer (3) and the PRESSURE/SUCTION manometer (4) help to prevent a loss of liquid in case the manometers are overloaded.

The relief valves are incorporated in the REGULATED LOW PRESSURE gauge (11) and the suit simulator tank. The relief valve on the REGULATED LOW PRESSURE gauge (11) is preset at 200 to 230 psig and protects the gauge and rotameter system in case of gauge guard failure. The PRIMARY relief valve is preset at 15 psig and the SECONDARY relief valve is preset at 25 psig. These relief valves prevent overpressurization of the suit simulator tank.

VACUUM PUMP

The VACUUM PUMP (VP) operates from a 2 horsepower electric motor (fig. 11-3). The pump rotation is clockwise, when viewed from the rear of the test stand. The pump has the capability of evacuating the chamber at a rate of 22.5 cubic feet per minute (cfm) at 81 mm Hg (51,600 feet) simulated altitude. It is used to evacuate the chamber or draw flow of air, nitrogen, or air and nitrogen from an item under test. The VACWM



- 1. OIL FILL PORT (FILTER ON TOP)
- 2. OIL CASE COVER
- 3. OIL DRAIN CAP
- 4. OIL COVER WINDOW (SIGHT GAUGE)
- 5. INTAKE NIPPLE
- 6. VACUUM PUMP VENT
- 7. BELT PULLEY

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Figure 11-3.—Vacuum pump.

PUMP vent (54) must be opened one to two turns when you operate the pump (fig. 11-1).

WARNING

ALWAYS ENSURE THAT THE PUMP MOTOR HAS A FOUR-PRONG ELECTRICAL CONNECTION PLUG. ON MODEL 1172AS100 ENSURE THAT THE GROUNDING LUG IS IN PLACE AND SECURELY CONNECTED. A SIDE VIEW OF THE VACUUM PUMP IS SHOWN IN FIGURE 11-3.

SAFETY PRECAUTIONS

Before you attempt to operate the test stand, review the following safety precautions. These safety precautions must be observed before, during, and after test stand operation.

1. Ensure that the test stand is properly secured prior to opening the supply cylinder valve. Position the HIGH PRESSURE REGULATOR to LOAD, then to VENT, and ensure that the LOW PRESSURE REGULATOR is backed out and the other valves are turned fully to the right.
2. Keep the chamber door closed whenever possible.
3. Keep the test stand doors closed at all times.
4. Keep the test stand work tray closed when it is not in use.
5. Check the pump lubricant prior to turning the pump on (run for 2 minutes and check lubricant for proper level).
6. Keep your hands and head clear of belts and pulleys while checking the lubricant level.
7. Ensure the test stand is properly grounded by using the grounding lug.
8. Never use regulated high pressure and regulated low pressure together.
9. When the oxygen monitor alarm sounds, leave the room.
10. Do not panic when the test stand malfunctions.
11. When you use nitrogen, ensure that the room is well ventilated.
12. Use proper tools for the job you are performing.
13. Do not inhale lubricant, oxygen cleaning compound, or mercury fumes.
14. Wash pump lubricant or mercury from hands immediately.

15. Secure the test stand completely after use.
16. Never leave the test stand unattended while the pump is running.
17. When transporting the compressed nitrogen cylinder, you should ensure the protective cap is on.

MAINTENANCE

Maintenance on the oxygen components test stand is discussed in the following paragraphs.

MANOMETER PREPARATION

Maintenance on the 1172AS100 begins as soon as the test stand is uncrated. You should fill the OUTPUT, INPUT, and VENT FLOW manometers with a liquid that has a known specific gravity of 1.0. The liquid used for the 1172AS100 is a mixture of one part concentrated green manometer fluid (merian D-2930) mixed with 10 parts of water. To fill the manometers, your first step is to adjust the scale so that the zero is located half way between the full-up and the full-down position.

Remove the fill plugs from the manometer reservoirs and fill the reservoir until the fluid reaches the zero mark on the scale. After you have filled the reservoir to zero, replace the fill plugs.

To fill the pressure suction manometer with fluid, use red manometer fluid with a specific gravity of 1.9. The procedure is the same. Adjust the scale so the zero mark is half way between the full-up and full-down positions. You have one more type manometer to fill. The Hg manometer uses triple-distilled mercury. To fill this manometer, follow the same procedure that you used for the other manometers. Do not spill the mercury. If you do, notify your supervisor, and follow the special precautions for cleaning mercury spills.

PRESSURE/LEAKAGE TESTS

To ensure maximum operating efficiency, pressure/leakage tests must be performed periodically.

NOTE: Use systems schematic drawings as an aid in determining any malfunctions that may exist. You can find these schematics in NAVAIR 13-1-6.4.

Outward Leakage Test (Supply System)

The outward leakage test (fig. 11-1) is performed as follows:

1. Ensure the supply cylinder valve and all test stand valves are closed.
2. Open fully, then close the supply cylinder valve.
3. Note the pressure registered on gauge (9). After 2 minutes, reread the pressure on gauge (9). There should be no pressure drop (a drop in pressure indicates leakage).

Outward Leakage Test (Regulated High-Pressure System)

The outward leakage test is performed as follows:

1. Cap connection (18) in chamber.
2. Open supply cylinder valve.
3. Turn regulator (Q) to LOAD, and hold until 2,000 psig (or cylinder pressure) is indicated on gauge (10). The regulated low-pressure gauge should indicate the gauge guard cut-off pressure, 170 ± 5 psig.)
4. Close the supply cylinder valve and note the pressure on gauge (10). After 2 minutes, reread gauge (10). There should be no pressure drop (a drop in pressure indicates leakage).

NOTE: If pressure is registered on gauge (27), a leak is indicated in ON/OFF valve (L) or ON/OFF valve (G). A pressure drop on gauge (11) also indicates valve (G) is leaking. Valve (G) will be independently tested later.

Bleed pressure by turning (Q) to VENT. Open valve (S) to bleed system, then close valve (S).

Outward Leakage Test (Regulated Low-Pressure System)

The outward leakage test is performed as follows:

1. Open the supply cylinder valve. Turn the selector valve (F) to HIGH and the selector valve (D) to Hg.
2. Turn the ON/OFF valves (L) and (G) to ON.
3. Slowly turn the regulator (N) clockwise until 70 psig is indicated on gauges (1 1) and (27).

4. Return valve (L) to OFF and observe rotameter (8). Any leakage will be indicated by the ball rising in the rotameter tube. There should be no leakage.

5. Turn valve (F) to LOW RANGE position and observe rotameter (7). There should be no leakage.

6. Return valve (F) to HIGH RANGE, and valve (L) to ON.

7. Slowly adjust the regulator (N) until 160 psig is registered on gauge (11). Gauge (27) should indicate its gauge guard cut-off pressure of 145 ± 5 psig.

8. Turn the ON/OFF valve (L) to OFF and observe rotameter (8). There should be no leakage indicated.

9. Turn the selector valve (F) to LOW RANGE and observe rotameter (7). There should be no leakage indicated.

10. Decrease the pressure to 70 psig by opening valve (S), and turning regulator (N) in a counterclockwise direction.

Leakage Control Valve (E) and Leakage ON/OFF Valve (G) Tests

Perform leakage control valve and leakage ON/OFF valve tests as follows:

1. Connect a hose from connection (19) to tap (20) in the chamber, and observe rotameter (6). There should be no leakage indicated.

2. Turn the ON/OFF valve (G) to OFF and remove the cap from connection (18) in chamber.

3. Observe rotameter (7). There should be no leakage indicated.

Suit Simulator System Leakage Tests

Perform leakage tests on the suit simulator system as follows:

1. Open the shutoff valve (R) and valve (J) fully. Place the selector valve (O) to the ALT CHAMBER, and valve (M) to the suit simulator position.

2. Remove the hose from tap (20) and connect it to tap (21) (connecting connection (19) to tap (21)). Cap piezometer (26).

3. Place selector valve (D) in the H₂O position, and valve (F) in the HIGH RANGE position.

4. Open valve (E) slowly to maintain a pressure of 10.0 inches H₂O throughout the system as indicated on manometer (4). Close valve (E). Any further climb on manometer (4) indicates a leak through valve (H).

5. Open valve (E) to maintain 20.0 in. H₂O. When pressure is constant, observe rotameter (8). There should be no leakage.

6. Turn valve (F) to LOW RANGE. The rotameter (7) should indicate no leakage.

7. Return valve (F) to HIGH RANGE, and close valve (E). Remove the hose from connection (19) and allow the pressure to escape from the hose.

NOTE: Open valve (C) to aid in relieving pressure; then close it.

8. When the pressure has equalized, connect the hose from tap (21) to tap (20) in the chamber. Rotameter (6) should show no indication of leakage.

9. Remove the cap from Piezometer (26), and disconnect the hose between taps (20) and (21) in the chamber.

10. Turn the regulator (N) counterclockwise, and open valve (S) to bleed system. Close all test stand valves with the exception of valves (R) and (J).

Altitude Chamber and Suit Simulator Tank Inward Leakage Test

Perform the altitude chamber and suit simulator tank inward leakage test as follows:

1. Place valve (D) in the Hg position. Ensure the ON/OFF valves (G) and (L) are in the OFF position. Place valve (O) in the suit simulator position.

2. Close the chamber door and turn the vacuum pump motor ON.

3. Open the VACUUM CONTROL valve (B₁) and "ascend" to 30,000 feet. Close (B₁) and check to ensure that the same altitude is indicated on both altimeters (12) and (13). At 30,000 feet you will see the high-range altimeter start to climb and at 40,000 feet the low-range altimeter will no longer be in use. This happens automatically and the low-range altimeter will not be damaged.

4. Using valve (B₁) "ascend" to 40,000 feet; ensure that altimeters (12) and (13) register the same altitude.

5. Using the VACUUM CONTROL valve (B₁), ascend to 52,000 feet. (Altitude is indicated on altimeter (12).)

6. Close (B₁); after a 2-minute stabilization period, record the altitude indicated on altimeter (12). Altitude "loss" should not exceed 1000 feet in 20 minutes.

PERIODIC INSPECTIONS

Periodic inspections consist of daily, weekly, biweekly, and monthly inspections. Perform these inspections at the prescribed intervals using the procedures described in the following text.

Daily Inspection

Perform the daily inspection as follows:

1. Check the vacuum pump lubricant for the proper level (run the pump for 2 minutes and recheck for proper level).

2. Inspect the gauges and manometers for cleanliness, fogged or broken glass, and zero or normal indications.

3. Inspect the altitude chamber door for cleanliness, chips, scratches or cracks. Check the gaskets for excessive wear or deterioration.

4. Inspect the connections and adapters for cleanliness and distortion.

5. Check the identification plates for cleanliness, legibility, and security of attachments.

Weekly Inspection

The weekly inspection includes all the tasks of the daily inspection and the following additional tasks:

1. Inspect the polyethylene tubing, fittings, connections, and rubber couplings for the correct fit, dirt or excessive dust, pin holes, radical bends or kinks, surface abrasions and heat blisters.

2. Inspect the gauges, manometers, and flowmeters for the correct calibration decals, proper fluid level, and cleanliness of manometer and flowmeter tubes.

3. Perform the pressure leakage tests in accordance with NAVAIR 13-1-6.4.

Biweekly Inspection

The biweekly inspection includes all the tasks of the weekly inspection and the following additional tasks:

1. Inspect the pump drive belt for proper tension, pulley alignment, excessive belt wear, and tightness of pulley setscrews.
2. Perform the orifice calibration check in accordance with AVAIR 13-1-6.4.
3. Perform the flowmeter intercomparison test in accordance with NAVAIR 13-1-6.4.

Monthly Inspection

The monthly inspection includes all the tasks of the biweekly inspection and the following additional tasks:

1. Inspect the N₂ and air inlet connectors for dirt, foreign matter, corrosion, stripped threads, and badly scored surfaces.
2. Inspect the gaskets at bulkhead fittings and vacuum pump filters for deterioration and proper fits and alignments.
3. Inspect the copper tubing for corrosion and tightness of soldered joints.
4. Inspect the altitude chamber for cleanliness, proper fit and alignment of gaskets, excessive scratches on chamber door, leaks or corrosion at pipe fittings, and wear of the door gasket.
5. Inspect all tubing and piping for tightness and proper alignment.
6. Inspect all electrical plugs, connectors, and wiring for physical damage, bent pins, loose connections, and security of cables.
7. Inspect all control valves for cleanliness and tightness of mounting nuts and knobs.

VOL-O-FLO CALIBRATION

The intercomparison test compares the input and output Vol-O-Flo elements to determine if the flowmeters need calibration. It is performed more often than the orifice calibration test as it is quicker and easier to perform.

The orifice calibration check accurately determines whether the output Vol-O-Flo is within calibration tolerances.

When a test stand fails the intercomparison test, an orifice calibration check is performed. Failure of the intercomparison test and orifice

calibration check requires the removal and cleaning of the input and output Vol-O-Flo elements.

NOTE: Prior to performing these calibration checks, you should ensure that there is no test stand leakage.

After cleaning, drying, and reinstallation of the Vol-O-Flo elements, both the intercomparison test and the orifice calibration check must be repeated. Failure of the above tests after cleaning will require the test stand be calibrated with a master calibrator, used by the metrology calibration team.

VOL-O-FLO ELEMENT CLEANING

To clean the Vol-O-Flo element, proceed as follows:

1. Disconnect the tubes from Vol-O-Flo manometers.

NOTE: Prior to removal of the element, mark the direction of the flow to ensure proper reinstallation.

2. Disconnect the element from the plumbing system by removing the hose and hose clamps at the ends of the element.
3. Mix a cleaning solution of 4 percent liquid detergent and water. (Mix 6 ounces of detergent with 1 gallon of water.)
4. Flush the element in reverse from the direction in which the air normally flows.
5. After the element has been well flushed, the detergent is rinsed out immediately with clean water.
6. Install the element in the test stand, and create a flow through the element for approximately 1 hour to ensure that it is completely dry.
7. After the element is dried, the test stand is leak-tested.
8. Perform an intercomparison test and orifice calibration check in accordance with the NAVAIR 13-1-6.4.

LIQUID OXYGEN CONVERTER TEST STANDS

Liquid oxygen converters are another group of items that you, as a PR, are required to test and repair. There are two test stands designed to test the oxygen converters. The operation, maintenance, and parts are, with a few minor

exceptions, basically identical. The part numbers for the two test stands are 59A120, manufactured by Aerojet-General Corporation, and the 31TB1995-1, manufactured by Pioneer.

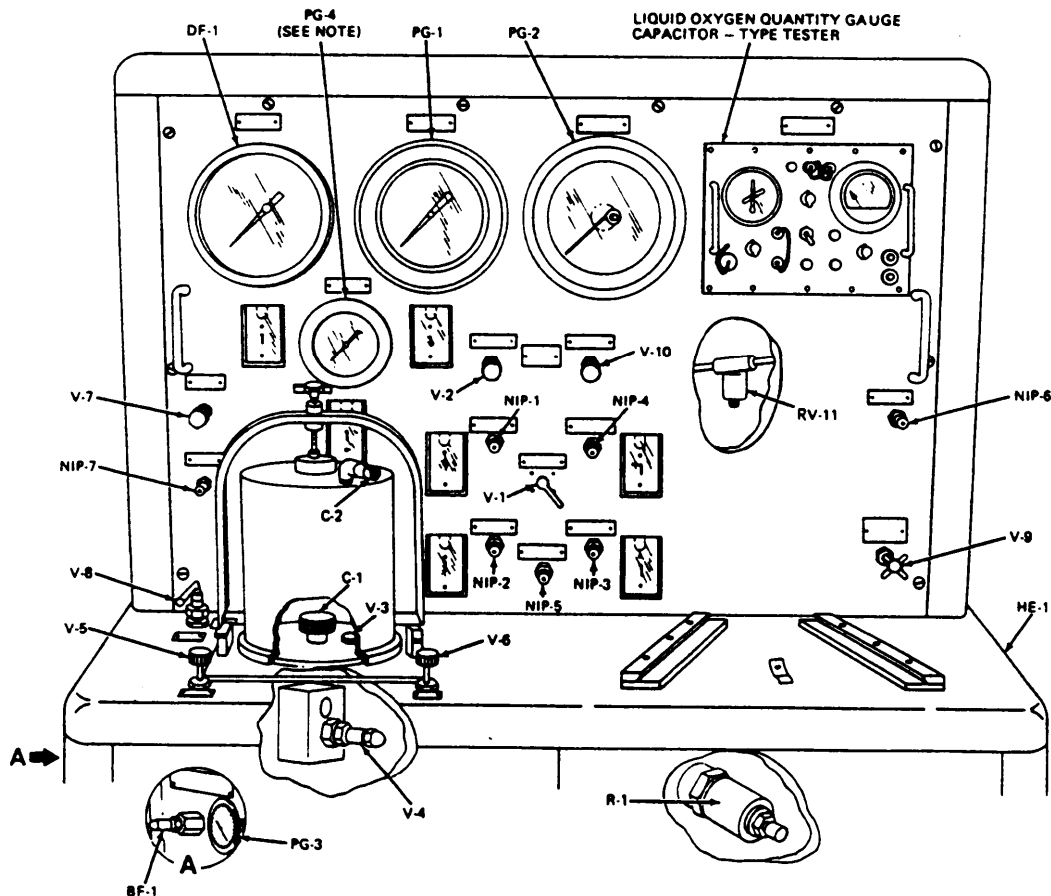
FUNCTIONS

The 59A120 test stand (fig. 11-4) is designed to test liquid oxygen converters, components, and

rigid seat survival kit (RSSK) components. This function is accomplished by the converter routing a test gas through various valves, gauges, and tubing to the item under test.

Bell Jar

The bell jar is used for testing components having more than one possible area of leakage.



- | | | | |
|-------|--|-------|--|
| 1 | Correction Card Holder | PG-3 | 0-3000 PSIG Supply Pressure Gauge |
| BF-1 | Special Bulkhead Fitting | PG-4 | 0-15 PSIG Low Pressure Test Gauge (See Note) |
| C-1 | Bell Jar Bottom Coupling | R-1 | 0-160 PSIG Oxygen Pressure Regulator |
| C-2 | Bell Jar Top Coupling | V-1 | Flowmeter Selector Valve |
| DF-1 | 0-100 INH ₂ O Differential Pressure Gauge | V-2 | Test Pressure Gauge To Bell Jar Valve |
| HE-1 | Heat Exchanger (Not Shown) | V-3 | 5-15 PSI Relief Valve (Set At 5 PSI) |
| NIP-1 | 0-0.25 LPM Flowmeter Connection | RV-4 | 0-500 PSI Relief Valve (Set At 180 PSI) |
| NIP-2 | 0-1 LPM Flowmeter Connection | V-5 | System Bleed Valve |
| NIP-3 | 0-50 LPM Flowmeter Connection | V-6 | Oxygen Supply Valve |
| NIP-4 | 0-150 LPM Flowmeter Connection | V-7 | Differential Pressure Bleed Valve |
| NIP-5 | Converter Supply Outlet Connection | V-8 | Differential Pressure Shut-Off Valve |
| NIP-6 | Supply To Converter Connection | V-9 | Converter Supply Flow Control Valve |
| NIP-7 | Differential Pressure Gauge Connection | V-10 | Test Pressure Gauge Build-Up And Flow Valve |
| PG-1 | 0-160 PSIG Test Pressure Gauge | RV-11 | 100-120 PSI Relief Valve (Set At 110 PSI) |
| PG-2 | Flowmeter Indicator Gauge | | |

NOTE: 59A120 ONLY

Figure 11-4.—Liquid Oxygen Converter Test Stand 59A120 control panel and counter top.

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Relief Valve, RV-11

Differential Pressure Gauge, DF-1

Converter Supply Connection, NIP-6

The schematic diagram illustrates the 59A120 system, which includes the following components and connections:

- Gas Sources:**
 - PG-1 (0-180 PSIG):** Connected to the top of the Bell Jar.
 - PG-2 (0-10 INH₂O):** Connected to the top of the HE-1 heat exchanger.
 - PG-3:** A pressure gauge connected to the line between BF-1 and R-1.
 - PG-4 (0-15 PSIG):** Connected to the line between GP-1 and the Bell Jar.
- Flow Meters and Flow Rates:**
 - FLM-1 (0-0.25 LPM):** Connected to NIP-1.
 - FLM-2 (0-1.0 LPM):** Connected to NIP-2.
 - FLM-3 (0-50 LPM):** Connected to NIP-3.
 - FLM-4 (0-150 LPM):** Connected to NIP-4.
- Valves and Pumps:**
 - V-1:** A pump or valve connected to the top of the HE-1 heat exchanger.
 - V-2, V-7, V-8, V-9, V-10:** Various control valves throughout the system.
 - GP-1:** A gas pump or generator connected to the Bell Jar.
 - R-1:** A reactor or resistor connected to the bottom of the Bell Jar.
- Other Components:**
 - BELL JAR:** The central component where the reaction or process occurs.
 - ADAPTER FIXTURE:** Connected to the bottom of the Bell Jar.
 - HE-1:** A heat exchanger with a coiled tube.
 - NIP-1 through NIP-5:** Various inlet and outlet ports.
 - RV-3, RV-4, RV-11:** Various valves or regulators.
 - BF-1:** A component connected to the line between PG-3 and R-1.

NOTE: USED ON 59A120 ONLY

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converter supply flow control valve V-9 controls the flow of oxygen from the liquid oxygen converter through the heat exchanger HE-1 to the buildup and flow valve V-10, and then to the adapter fixture.

Linear Flow Elements

There are four linear flow elements. Each measures a different flow rate in liters per minute (LPM). By using a hose assembly connected from NIP-5 (converter supply outlet connection) to the correct one of the linear flow elements (NIP-1 for 0-00.25 LPM, NIP-2 for 0-1.0 LPM, NIP-3 for 0-50 LPM, or NIP-4 for 0-150 LPM), and turning the flowmeter selector valve, you can measure leakage from an item under test.

Liquid Oxygen Quantity Gauge Capacitor-Type Tester

The liquid oxygen quantity gauge capacitor-type tester is located on the upper front panel of the test stand and operates on 115 V_{ac}, 400-cycle current. It is used to measure capacitance and electrical insulation of the capacitance probe.

Flow of Oxygen

As you turn on the supply of gas, it flows into the test stand through a special bulkhead fitting BF-1 (fig. 11-4), and it is indicated on the 0-3,000 psig pressure gauge PG-3. It then flows to the adjustable pressure regulator R-1. The regulator is preset to deliver 160 psig to the remainder of the test stand through oxygen supply valve V-6. Oxygen supply valve V-6, a needle-type valve, admits oxygen to the adapter fixture and controls oxygen pressure to an item under test. From the adapter fixture, the test gas is routed to the following valves, gauges, and disconnects:

Test gas enters the bell jar bottom coupling C-1. Your test item is also attached to this coupling. From C-1 it flows to the needle metering valve V-2, which allows the flow to continue to a test pressure gauge PG-1.

NOTE: When opening valve V-2, you must close valve V-10. This prevents oxygen from entering the converter side of the test stand.

The test pressure gauge PG-1 indicates the pressure applied to the item under test. The oxygen flow also goes from the adapter fixture

to the differential pressure gauge shutoff valve V-8. This valve prevents pressure from being admitted to the high side of the differential pressure gauge DF-1 when the gauge is not being used. Another flow from the adapter fixture is to the system bleed valve V-5. This valve is a needle-type valve, and it is used to bleed the pressure from the test stand. On every test stand you will find a safety valve. In this case, we have a relief valve V-4 that prevents excessive pressure buildup in the test stand. The valve is leaktight at 160 psig, and is set to relieve at 180 psig.

MAINTENANCE

Maintaining and preparing the test stand for use is divided into five separate tasks: installation, visual inspection, correction card preparation, calibration, and leak testing. These tasks, fully described in the following paragraphs, are outlined briefly below:

1. Installation includes selecting a suitable space, mounting, connecting to a suitable power supply, and an oxygen source.
2. The visual inspection is performed to ensure the test stand has not been damaged during shipment and installation.
3. Correction/calibration cards (fig. 11-6) provide an easy reference upon which indicated flows and pressures are recorded. Actual mandatory flows and pressures are taken from NAVAIR 17-15BC-20 and are prerecorded on the correction/calibration cards. The actual LPM flow must be converted to the indicated inches of H₂O flow and to millimeter (mm) flow by using the applicable flowmeter calibration graphs. This conversion is performed by the metrology calibration team.

NOTE: Additional actual pressures and flows have been added to the correction cards in figure 11-6. Addition of these pressures and flows reflect required actual pressures and flows needed to bench test RSSK kits and all models of LOX converters now in service.

4. Periodic leakage tests are conducted on the accessories section, bell jar assembly, and the entire test stand.

5. Calibration of the test stand is required to be performed prior to use. Calibration procedures are performed at 6-month intervals by the onsite metrology calibration team. Additional calibrations are not required.

CORRECTION CARD NUMBER 1	
ACTUAL IN. H ₂ O	INDICATED IN. H ₂ O
100	
80	
60	
40	
20	
10	

CORRECTION CARD NUMBER 2	
ACTUAL PSIG	INDICATED PSIG
160	
140	
130	
120	
110	
100	
95	
90	
85	
80	
76	
70	
60	
55	
40	
35	
30	
25	
20	

CORRECTION CARD NUMBER 3	
ACTUAL PSIG	INDICATED PSIG
14	
12	
10	
8	
6	
4	
2	

CORRECTION CARD NUMBER 4		
ACTUAL LPM	INDICATED IN. H ₂ O	MM
150		
122		
120		
100		
90		
75		
50		

0-150 LPM

CORRECTION CARD NUMBER 5		
ACTUAL LPM	INDICATED IN. H ₂ O	MM
40		
30		
20		
10		
5		
3		

0.0-50 LPM

CORRECTION CARD NUMBER 6		
ACTUAL LPM	INDICATED IN. H ₂ O	MM
1.0		
0.75		
0.50		
0.25		

0.0-1.0 LPM

CORRECTION CARD NUMBER 7		
ACTUAL LPM	INDICATED IN. H ₂ O	MM
0.20		
0.15		
0.10		
0.08		
0.07		
0.06		
0.05		
0.03		
0.02		
0.01		

0.0-0.25 LPM

Figure 11-6.—Calibration correction cards.

Installation

The test stand may be installed in any convenient location. Table 11-1 includes nominal dimensions of the test stand. Total space requirements can be determined by adding a reasonable working area to the dimensions given in the table.

NOTE: The test stand has drilled flanges to allow stable mounting. If shock pads are placed under the stand, they must extend under the whole stand to give even distribution of support.

Power requirement for the test stand is 115 Vat, 400-cycle, single-phase service. The test stand is connected to a suitable power source by the electrical cable assembly.

A 300 to 2,000 psig oxygen source is required. A metal strap on the left rear of the test stand is provided for mounting and securing the oxygen supply cylinder.

Visual Inspection

Visually inspect the test stand for the following:

1. Dial glasses for cracks or breakage
2. All hoses for cracks or breaks
3. All pipe and hose fittings for security of connection, worn, stripped or crossed threads
4. All tubing for severe dents or punctures
5. All valves for body cracks
6. Heat exchanger for rupture, severe dents, or punctures
7. Gauge tester for damaged or loose parts, and tightness of terminals and connectors

Any components found to be damaged or defective should be repaired or replaced. Refer to NAVAIR 17-15BC-20 for part numbers.

Test Stand Leakage Tests

Test stand leakage tests are performed by personnel attached to the oxygen shop and consist of setting the oxygen pressure regulator, leak testing the accessories section, test stand section, and Bell Jar assembly.

SETTING THE OXYGEN PRESSURE REGULATOR.— To set oxygen pressure regulator

Table 11-1.—Test Stand Installation

LEADING PARTICULARS			
Width (in.)	Depth (in.)	Height (in.)	Weight (lb)
50.12	24.06	68.06	460
GENERAL TECHNICAL CHARACTERISTICS			
Indicator		Range	
Supply Pressure Gauge		0 to 3000 psig	
Test Pressure Gauge		0 to 160 psig	
Low Pressure Test Gauge (59A120 only)		0 to 15 psig	
Differential Pressure Gauge		0 to 100 in H ₂ O	
Flowmeter Indicator		0 to 10 in H ₂ O	
Leakage Linear Flow Element No. 1		0 to 0.25 liters per minute (lpm)	
Leakage Linear Flow Element No. 2		0 to 1.0 lpm	
Rate Linear Flow Element No. 1		0 to 50 lpm	
Rate Linear Flow Element No. 2		0 to 150 lpm	
Liquid Oxygen Quantity Gauge Capacitor-Type Tester			
Capacitance measuring			
range		0 to 5,000 uuf in four ranges.	
accuracy		± 0.5% of reading or 0.25% of maximum value of applicable capacitance measuring range, whichever is greater.	
Insulating resistance measuring			
range		0 to 10,000 megohms in four ranges.	
accuracy		± 0.125 inch of scale length.	
Maximum voltage at test terminals		Less than 50 Vac.	
Short Circuit Current of test terminals		Less than 200 milli- amperes.	

R-1 to maintain 160 psig with 1,800 psig supply pressure applied, proceed as follows:

CAUTION

VALVES V-2, V-5, V-6, V-7, AND V-10 ARE METERING (NEEDLE) VALVES. OVERTIGHTENING THESE VALVES WILL DAMAGE THE VALVE SEAT. ONLY FINGERTIGHT PRESSURE SHOULD BE USED WHEN YOU CLOSE THESE VALVES.

1. Ensure that all test stand valves are closed, and plug the bell jar bottom coupling C-1.

WARNING

WHEN YOU WORK WITH OXYGEN, MAKE CERTAIN THAT CLOTHING, TUBING FITTINGS, AND EQUIPMENT ARE FREE OF OIL, GREASE, FUEL, HYDRAULIC FLUID, OR ANY COMBUSTIBLE MATERIALS. FIRE OR EXPLOSION MAY RESULT WHEN EVEN SLIGHT TRACES OF COMBUSTIBLE MATERIAL COME IN CONTACT WITH OXYGEN WHEN IT IS UNDER PRESSURE.

2. Open the oxygen supply cylinder valve.

NOTE: When you set regulator R-1, a MINIMUM of 1,800 psig of oxygen pressure is applied to the regulator.

3. Open the test pressure gauge to bell jar valve V-2 slowly, and fully open the oxygen supply valve V-6.

4. Loosen the hex locknut located on the front of regulator R-1. Turn the T-handle until 160 psig registers on the test pressure gauge PG-1. Tighten the hex locknut, and your oxygen pressure gauge is now set.

5. Close the oxygen supply cylinder valve and open the system bleed valve V-5 to bleed pressure from the system. After bleeding the pressure, remove the plug from the bell jar bottom coupling C-1.

LEAKAGE TEST, ACCESSORIES SECTION.— TO perform the leakage test on the

accessories section of the test stand, proceed as follows:

1. Install the nipple assembly in the bell jar bottom coupling C-1. Connect one end of the hose to the adapter, and the other end to the differential pressure connection NIP-7.

2. Ensure that the test pressure gauge to bell jar valve V-2 is open. The system bleed valve V-5, the test pressure gauge buildup, and the vent valve V-10 and the differential pressure bleed valve V-7 are closed.

3. Open the differential pressure shutoff valve V-8 and the oxygen supply cylinder valve.

4. Slowly open the oxygen supply valve V-6 until 160 psig is indicated on test pressure gauge PG-1.

5. Now close the oxygen supply valve V-6. Leakage will be indicated by a drop in pressure on PG-1. Leakage should not be more than 2 psig in 10 minutes.

6. Leave all hoses and valves in their present position and start your test stand leakage test.

LEAKAGE TEST, TEST STAND.— TO perform the leakage test on the entire test stand proceed as follows:

1. Open the converter supply flow control valve V-9 and test pressure gauge buildup and the flow valve V-10.

2. Plug the converter supply outlet NIP-5 and the supply converter connection NIP-6. Ensure that the system bleed valve (V-5) is closed.

3. Open the supply valve V-6 until the relief valve RV-11 unseats. (The relief valve is set to relieve at approximately 110 psig, and be leaktight at 100 psig.) Using the system bleed valve V-5, decrease pressure until 100 psig is indicated on test pressure gauge PG-1. Close valve V-6. Leakage will be indicated by a drop in pressure on PG-1. Leakage should be no more than 10 psig in 10 minutes.

4. Bleed the test standby opening the system bleed valve (V-5). Close all the test stand valves. Remove the plugs from the converter supply outlet NIP-5 and the plug from the supply converter connection (NIP-6).

BELL JAR ASSEMBLY LEAKAGE TEST.— To perform a leakage test on the bell jar assembly, proceed as follows:

1. Remove the hose assembly and the nipple assembly from the bottom bell jar coupling C-1. Disconnect the opposite end of the hose from differential pressure connection NIP-7.

Table 11-2.-Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	REMEDY
0-160 psig pressure gauge (PG-1) indicates low consistently	Leaky fittings	Perform leak test as instructed in NAVAIR 13-1-6.4 and tighten fittings as necessary.
0-160 psig pressure gauge (PG-1) indicates high	Pressure gauge (PG-1) pointer not zeroed	Request onsite metrology calibration team to adjust pressure gauge zero.
0-160 psig pressure gauge (PG-1) pointer pegs	Pressure regulator (R-1) setting incorrect	Adjust regulator setting as instructed in NAVAIR 13-1-6.4.
(59A120 only) 0-15 psig pressure gauge (PG-4) indicates low consistently	Leaking fittings	Perform leak test as instructed in NAVAIR 13-1-6.4 and tighten fittings as necessary.
(59A120 only) 0-15 psig pressure gauge (PG-4) indicates high	Pressure gauge (PG-4) pointer not zeroed	Request onsite metrology calibration team to adjust pressure gauge zero.
0-100 in H ₂ O differential pressure gauge (DF-1) indicates high	Pressure gauge (DF-1) pointer not zeroed	Request onsite metrology calibration team.
0-100 in H ₂ O differential pressure gauge (DF-1) indicates low	Leaky shut-off differential pressure valve (V-8)	Perform leak test as instructed in NAVAIR 13-1-6.4 and tighten fittings or replace valve.
Linear flow element (FLM 1, 2, 3, or 4) indicates low consistently	Defective flow element	Request onsite metrology calibration team to recalibrate flow element.
	Defective flowmeter indicator (PG-2)	Check flowmeter indicator (PG-2) for leaks or friction.
Flow element (FLM 1, 2, 3, or 4) indicates correctly over part of scale only	Defective flow element	Request onsite metrology calibration team to recalibrate flow element.
	Defective flowmeter indicator (PG-2)	Check flowmeter indicator (PG-2) for leaks or friction.

2. Ensure that the differential pressure bleed valve V-7, the test pressure gauge to bell jar V-2, and the system bleed valve V-5 are closed. Open the differential pressure shutoff valve V-8.

3. Place the bell jar on the adapter fixture and secure it with a clamp. Now plug the bell jar top coupling C-2.

4. Open the oxygen supply valve V-6 slowly until 100 inches of H₂O is indicated on the differential pressure gauge DF-1. By closing valve V-6, leakage will be indicated by a drop in pressure on DF-1. There must not be more than 2 inches of H₂O in 10 minutes.

5. Close the oxygen supply cylinder valve and open the system bleed valve V-5 to bleed the system.

6. Secure all test stand valves. Leave the system bleed valve V-5 open.

CAUTION

WHEN THE TEST STAND IS SECURED, ALL VALVES WITH THE EXCEPTION OF THE SYSTEM BLEED VALVE V-5 MUST BE CLOSED. VALVE V-5 IS LEFT OPEN TO PREVENT THE ACCIDENTAL BUILDUP OF PRESSURE IN THE SYSTEM.

CLEANING

Clean all external parts, test adapters and connections, gauge glasses, bell jar, O-ring, and terminals of the liquid oxygen quantity gauge capacitor-type tester with a soft, lint-free cloth. The cloth may be dampened with oxygen cleaning compound (MIL-C-81302).

PERIODIC INSPECTIONS

Periodic leakage inspections are required to be performed weekly. A pressure regulator (R-1) setting must be performed weekly also. In addition to the inspection requirements, the test stand should be visually inspected for cleanliness, freedom from oil and grease, missing or damaged parts, and general condition.

TROUBLESHOOTING

Refer to table 11-2, Troubleshooting Chart, for probable trouble causes and remedies. Information in this chart is intended primarily to aid oxygen shop personnel in diagnosing problems most likely to be encountered in their daily use of the test stand. Refer to NAVAIR 17-15BC-20 for parts removal and replacement.

Upon completion of any maintenance actions, complete the maintenance forms outlined in the NAVAIR 13-1-6.4.

